

REMARKS

Claims 1-3 and 6-16 are pending for further examination. Claims 1, 8, 13 and 14 are currently amended. Claims 15 and 16 are new.

Claim Objections

Claims 13 and 14 have been amended to correct several informalities as required by the Office action. Accordingly, applicants respectfully request withdrawal of the objections.

Claim Rejections

Claims 1-3 and 6-12 were rejected as unpatentable over Noguchi (U.S. Patent No. 6,107,679) in view of Higashi et al. (U.S. Patent No. 5,918,113). Claims 13 and 14 were rejected as unpatentable over the Noguchi patent and the Higashi patent, as applied to claims 1 and 8, and further in view of Patterson et al. (U.S. Patent No. 4,843,188). In view of the foregoing amendments and the following remarks, applicants respectfully request withdrawal of the rejections and allowance of the claims.

Claim 1 is amended to recite, in part, that a semiconductor device includes a first conductive pattern which “extends under the semiconductor element and to the edge” of a step portion in a mounting substrate. An example of this feature is disclosed in the specification on pg. 7, lines 17-19 and in FIG. 1B. In that example, a plating line 12B, which is part of first conductive pattern 12, extends to the edge of step portion 15. Extending the conductive pattern to the edge of the step portion increases the area of contact between the conductive pattern and a covering resin and can, in some implementations, improve adhesion to the resin. Extending the conductive pattern also can simplify the electroplating process by allowing the conductive pattern to be connected to a common plating line that extends along a device border.

The Office action concedes that neither the Noguchi patent nor the Higashi et al. patent discloses or suggests a first conductive pattern that extends to the edges of a main surface. However, the Office action asserts that the Patterson et al. patent discloses a first conductive pattern extending laterally to the edge of a step portion of a first main surface. The Office action

further alleges that it would have been obvious to one of ordinary skill in the art to apply the extension of the first conductive pattern as shown in the Patterson et al. patent to a device based on the Noguchi and Higashi et al. patents in order to ensure reliability by increasing the bonding area or in order to provide a testing area. As explained below, applicants respectfully disagree and submit that it would not have been obvious to combine the features of the Patterson et al. patent with the Noguchi patent and Higashi et al. patents so as to obtain the present claims.

First, contrary to the statement in the Office action, there would have been no need to increase the bonding area of conductive patterns 3 in the Noguchi patent in order to increase reliability. FIGS. 3(b), 4(b), 5(b), 6(b) and 7(b) in the Noguchi patent show that the conductive patterns 3 already extend sufficiently beyond the region to which the thin metal lines 10 are bonded. Therefore, any further extension of the conductive patterns 3 would merely provide additional material with no other function or purpose. Furthermore, there is no disclosure or suggestion in the Noguchi patent that the reliability of the bonding is poor or might require improvement. Instead, the Noguchi patent discloses that wire bonding is a known technique in the art (col. 2, lines 34-35). Accordingly, a person of ordinary skill would recognize that wire bonding is a refined technology and would not need to improve its reliability.

Second, it would not be possible to use the conductive patterns 3 of the Noguchi patent as a testing area. FIG. 7(b) of the Noguchi patent clearly shows that the conductive patterns 3 are covered with a resin 11. Regardless of how far the conductive patterns 3 are extended on the surface of the device 8, it would not be possible to apply testing equipment to the patterns due to the presence of the resin 11. Furthermore, the Noguchi patent shows that the semiconductor device 8 is connected to external electrodes 2 by means of thin metal lines 10, conductive patterns 3 and vias 4. Therefore, any testing may be done using the external electrodes 2 and would not require the use of conductive patterns 3.

In addition, it would not have been obvious to extend the terminal contacts 12a of the Higashi et al. patent to the “edge of [a] step portion” as recited in pending claims 1 and 8. The Higashi et al. patent discloses that a semiconductor chip 30 is bonded to electrode terminal contacts 12a using electrode terminals 32 such as gold bumps (col. 4, lines 7-12). Although

extending the length of contacts 12a may increase the bonding area, there is no disclosure or suggestion in the Higashi et al. patent that the contacts 12a should be extended as far as the *edge* of the device. Furthermore, the Higashi et al. patent already teaches a method for improving the reliability using conductive particles 22, which conduct along the surface of the circuit board 10 (col. 4, lines 30-43). Therefore, even if there were a slight misalignment of the chip 30, the conductive particles 22 would ensure a reliable electrical connection. Accordingly, extending the length of terminal contacts would not have been necessary.

Also, it would not be possible to use the terminal contacts 12a as a testing area. Similar to the Noguchi patent, the Higashi et al. patent discloses that the terminal contacts 12a are covered with adhesive film 20 such as epoxy resin. Therefore, it would not be possible to test the terminal contacts 12a due to the presence of the resin. Furthermore, the Higashi et al. patent discloses that the chip 30 is externally connected by means of terminal contacts 12, through-hole 16, land 14 and solder ball 40. Any testing can be accomplished using the solder ball 40 and would not require extending terminal contacts 12. Therefore, it would not have made sense to extend the terminal contacts 12 of the Higashi et al. patent in order to provide a testing area.

At least for the foregoing reasons, independent claims 1 and 8 should be allowed.

Claims 2-3, 6-7, 9-16 depend from those claims and should be allowed for at least the same reasons as discussed above.

In addition, the dependent claims recite features that are independently allowable. For example, claims 15 and 16 recite that the semiconductor element is “on the first conductive pattern and in direct contact with a surface of the first conductive pattern.” An example is disclosed in the specification on pg. 7, lines 14-21 and in FIG. 1B which shows a semiconductor element 13 in direct contact with a surface of first conductive pattern 12. An advantage of mounting the semiconductor element directly to a surface of the first conductive pattern is that heat transferred away from the semiconductor element and to the second conductive pattern may be maximized. Furthermore, using sealing resin to fix the semiconductor element to the surface of the substrate eliminates the need for a conductive solder/adhesive between the semiconductor

element and the first conductive pattern. Eliminating the solder/adhesive between the semiconductor and first conductive pattern may reduce fabrication costs since less material is required.

In contrast, none of the cited references discloses or suggests a semiconductor element “in direct contact with a surface of a first conductive pattern.” Instead:

- (i) the Noguchi patent shows an adhesive 13 and solder resist 6 between semiconductor device 8 and conductive patterns 3 (*see FIG. 1(b)*);
- (ii) the Higachi patent shows an electrode terminal 32 and conductive particles 22 between semiconductor chip 30 and terminal contacts 12a (*see FIG. 1*); and
- (iii) the Patterson patent discloses that a chip 12 is connected to a metallized bonding pad 14 using solder (col. 3, lines 66-67).

At least for these additional reasons, claims 15 and 16 should be allowed.

It is believed that all of the pending claims have been addressed. However, the absence of a reply to a specific rejection, issue or comment does not signify agreement with or concession of that rejection, issue or comment. In addition, because the arguments made above may not be exhaustive, there may be reasons for patentability of any or all pending claims (or other claims) that have not been expressed. Finally, nothing in this paper should be construed as an intent to concede any issue with regard to any claim, except as specifically stated in this paper, and the amendment of any claim does not necessarily signify concession of unpatentability of the claim prior to its amendment.

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The fee for the Petition for Extension of Time is being paid concurrently herewith on the Electronic Filing System (EFS) by way of Deposit Account authorization. Please apply any other charges or credits to Deposit Account No. 06-1050.

Respectfully submitted,

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